

# PATENT COOPERATION TREATY

## PCT

### INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY


(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

REC'D 21 SEP 2005

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Applicant's or agent's file reference 109654/TFU		<b>FOR FURTHER ACTION</b>		See Form PCT/IPEA/416
International application No. PCT/NO2004/000187		International filing date (day/month/year) 24.06.2004	Priority date (day/month/year) 27.06.2003	
International Patent Classification (IPC) or national classification and IPC C02F1/00				
Applicant SINVENT AS et al.				
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau a total of 3 sheets, as follows:</p> <p><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>				
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input checked="" type="checkbox"/> Box No. VIII Certain observations on the international application</p>				
Date of submission of the demand 27.04.2005		Date of completion of this report 20.09.2005		
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465		Authorized Officer  Grigoraki, E  Telephone No. +49 89 2399-8353		



**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/NO2004/000187

**Box No. I Basis of the report**

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:

- ☐ international search (under Rules 12.3 and 23.1(b))
- ☐ publication of the international application (under Rule 12.4)
- ☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements\*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

**Description, Pages**

1-21  
as originally filed

**Claims, Numbers**

1-14  
filed with telefax on 02.09.2005

**Drawings, Sheets**

1/6-6/6  
as originally filed

☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/figs
- ☐ the sequence listing (*specify*):
- ☐ any table(s) related to sequence listing (*specify*):

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/figs
- ☐ the sequence listing (*specify*):
- ☐ any table(s) related to sequence listing (*specify*):

\* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT  
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**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

**1. Statement**

Novelty (N)	Yes: Claims	1-14
	No: Claims	
Inventive step (IS)	Yes: Claims	1-14
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-14
	No: Claims	

**2. Citations and explanations (Rule 70.7):**

**see separate sheet**

**Box No. VIII Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

**see separate sheet**

**Conc. Section V:**

1). Reference is made to the following documents:

D1: GB-A-1 360 797

D2: GB-B-2 358 640

D3: US-A-3 415 747

D4: US-A-3 217 505

D5: US-A-3 058 832

D6: US-A-2 904 511

- 2). Closest prior art D1 discloses a method for decontamination of water by using hydrate forming substances (HFS) and hydrate forming aids (HFA) to form hydrates in a first container (50). Upon separation of the purified water in separator (72) the HFS and HFA are recycled to the first container in which the hydrates are formed. Novelty as required by article 33(2) PCT of the method of claim 1 is established by the feature that some of the mixture of hydrate and contaminated water is recycled to the first container as hydrate forming "seeds".
- 3). The problem to be solved thereby vis-à-vis said prior art can be seen in how to ameliorate the process in terms of simplicity as well as efficiency or control for the formation of the hydrates. There is no hint in D1 or in D3-D6 for the solution claimed i.e recycling of the mixture = addition of already formed hydrate seeds during the hydrates formation.

D2 is addressed to a method for transporting a flow of fluid hydrocarbons containing water and suggests to form hydrates under suitable pressure/temperature conditions. In D2 hydrate particles (seeds) are recycled back to the first container in which the hydrates are formed. However D2 does not teach the feature that some of the mixture of hydrate and contaminated water is recycled to the first container as the hydrate forming "seeds" before the rest is passed to the separator (i.e directly with no more treatment involved) but moreover shows a recycle of dry hydrate particles upon further cooling (7) and separation thereof in separator (8). D2 would therefore also not in combination with D1 lead in an obvious manner to the method of claim 1. An inventive step in accordance with article 33(3) can be acknowledged.

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(SEPARATE SHEET)**

International application No.

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- 4). The device of claim 12, provided that the recycling means (5.13,32) are clearly defined therein (cf also remarks in VIII below conc. clarity), defines the means in apparative terms suitable to carry out the method and would also fulfil the requirements of article 33(2) and (3) PCT.
- 5). The method of claim 11 and the device of claim 14 for purification of gas contain all features of claims 1 or 12 respectively so that they would also fulfil the requirements of novelty/inventive step under article 33(2) and (3) PCT.
- 6). Claims 2-10 and 13 contain further preferred embodiments of the method of claim 1 or the device of claim 12 and fulfil also the requirements of articles 33(2) and (3) PCT.

**Conc. Section VIII:**

- 7). An essential feature for the invention i.e also for the device in accordance with the method of claim 1 is the pipe (5,13,32) for recycling a part of the mixture of hydrates and contaminated water passed to the separator (U) to the first container (T).

Since this feature is missing from the wording of claim 12 said claim is objectionable under article 6 PCT in the sense that not all essential features are defined therein.

## Patent Claims

1. Method for purification of contaminated water by hydrate formation and separation of hydrates from contaminated water enriched with contaminants, characterized in that the water to be purified is passed via a first pipe (31) into a first container (T) with suitable pressure and temperature conditions to obtain hydrate formation, in said container (T) the water is mixed with a hydrate-forming compound which is supplied via a second pipe (36), some of the mixture of hydrate and contaminated water is recycled to said first container (T) via third pipe (32) as hydrate-forming seed, and the rest is passed to a separator (U) where the mixture is separated into contaminated water and pure hydrate, the hydrate is passed to a second container (W) via a fourth pipe (34/35), in said second container (W) the temperature is raised so that the hydrate dissociates into pure water and hydrate-forming compound, the hydrate-forming compound from said second container (W) is passed back to the first container for hydrate formation (T) via said second pipe (36), and the pure water is taken out as a product.
2. Method according to Claim 1, characterized in that the contaminants comprise one or more components selected from the group consisting of hydrocarbons, organic and inorganic salts, dust, mud, metals, sand, gas, radioactive compounds, and biological material.
3. Method according to Claim 1, characterized in that the contaminants which have been separated off are handled by recirculation to upstream process steps or deposition/disposal.
4. Method according to Claim 1, characterized in that hydrate formation is carried out in several steps by subjecting the contaminated water from the separator (D/U) to repeated hydrate formation processes in series until the concentration of contaminants in the contaminated water is too high for further hydrate formation.

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5. Method according to Claim 1,  
characterized in that the harvested hydrates from the separator (D/U) are subjected to a washing step prior to dissociation to pure water and hydrate forming gas.
6. Method according to Claim 1,  
characterized in that the hydrate forming compound supplied to the first container (C/T) through the second pipe (8/36) is selected from lower hydrocarbons, CO<sub>2</sub>, halogenated hydrocarbons, wherein halogen is selected from chlorine and fluorine, tetrahydrofuran, ethylene oxide, noble gases selected from helium, neon, argon, xenon, krypton, sulphur hexafluoride, dinitrogen oxide, preferably C<sub>1</sub>-C<sub>5</sub> hydrocarbons or CO<sub>2</sub>, more preferably methane, ethane, propane, CO<sub>2</sub>, most preferably methane or CO<sub>2</sub>.
7. Method according to Claim 1,  
characterized in that the pressure and temperature conditions are:  
T < 30°C, P > 1 bar, preferably T < 20°C, P > 5 bar, most preferably T < 10°C, P > 20 bar.
8. Method according to Claim 1,  
characterized in that the hydrate particles which are supplied through the third pipe (5, 13, 32) to the hydrate formation step have a diameter of maximum 3 mm, preferably maximum 500 µm, still more preferably maximum 100 µm.
9. Method according to Claim 1,  
characterized in that the hydrate harvesting process is selected from the group consisting of sedimentation, filtration, centrifugation, flotation.
10. Method according to Claim 1,  
characterized in that the hydrates dissociate through an increase in temperature and/or reduction in pressure.
11. Method for purification of gas,  
characterized in that the gas is bubbled through water for transfer of

gaseous contaminants to the water, prior to the water being subjected to a method for purification of water according to Claim 1.

12. Device for purification of contaminated water, characterized in that it contains a first pipe (31) for water to be purified, leading into a first container (T), a fifth pipe (33) leading from said first container to a separator (U), a sixth pipe (38) leading from said separator to a deposit area for contaminated water, a fourth pipe (34/35) leading from said separator to a second container (W), a second pipe (36) leading from said second container (W) to said first container (T), a seventh pipe (37) from said second reactor (W) for removal of purified water, and one or more heat exchangers (Z) providing cooling in the first container (T) and heating in the second container (W).

13. Device according to Claim 12, characterized in that it further comprises additional devices according to Claim 12 in series in a sufficient number to obtain a satisfactory concentration increase of the contaminants.

14. Device for purification of air/gas, characterized in that it comprises the device according to claim 13, where the seventh pipe (37) for purified water leads into a storage tank (S) serving as a washing chamber for polluted air/gas, and a pipe (41) for contaminated air/gas leading into said storage tank and another pipe (42) for purified air/gas leading out of said storage tank.